3.1 Air Quality

3.1.1 Sources of Information

Existing air quality in the vicinity of the project site was characterized using monitoring data collected by the Greater Vancouver Regional District (GVRD) and the British Columbia Ministry of the Environment, Lands and Parks (MELP). A five-year meteorological data set was constructed for the dispersion analyses using 1985 to 1989 surface observations from the Abbotsford, British Columbia Airport. Air pollutant emissions from the proposed project were based on data provided by the vendor (Siemens Westinghouse, the gas turbine manufacturer) and gas turbine emission studies sponsored by the United States Environmental Protection Agency (EPA).

3.1.2 Existing Conditions

3.1.2.1 Ambient Air Quality Standards

Ambient air quality standards have been established by EPA and the Washington State Department of Ecology. Primary standards are designed to protect human health with a margin of safety. Secondary standards are established to protect the public welfare from any known or anticipated adverse effects associated with these pollutants, such as soiling, corrosion, or damage to vegetation. The Northwest Air Pollution Authority (NWAPA) has adopted standards that are virtually identical to the state's ambient air quality standards. The national and state ambient air quality standards applicable to this project are shown in Table 3.1-1.

In addition to the ambient air quality standards, the Canadian Environmental Protection Act provides for three levels of air quality objectives: Desirable, Acceptable and Tolerable. The Province of British Columbia also has objectives that are generally similar to the Canadian national objectives. The GVRD has suggested objectives for pollutants of concern within its jurisdiction where no comparable federal objectives exist.

Table 3.1-1: Ambient Air Quality Standards and Prevention of Significant Deterioration Increments

Pollutant	National Primary	National Secondary	State of Washington	Class I PSD Increments	Class II PSD Increments
Total Suspended Particulate Matter (TSP)					
Annual Geometric Mean			60 $\mu g/m^3$		
24-hour Average			150 $\mu g/m^3$		
Inhalable Particulate Matter (PM10)					
Annual Arithmetic Mean	50 $\mu g/m^3$	50 $\mu g/m^3$	50 $\mu g/m^3$	1 $\mu g/m^3$	17 $\mu g/m^3$
24-hour Average	150 $\mu g/m^3$	150 $\mu g/m^3$	150 $\mu g/m^3$	5 $\mu g/m^3$	30 $\mu g/m^3$
Inhalable Particulate Matter (PM2.5)					
Annual Arithmetic Mean	15 $\mu g/m^3$	15 $\mu g/m^3$			
24-hour Average	65 $\mu g/m^3$	65 $\mu g/m^3$			
Sulfur Dioxide (SO_2)					
Annual Average	0.03 ppm		0.02 ppm	1 $\mu g/m^3$	20 $\mu g/m^3$
24-hour Average	0.14 ppm		0.10 ppm	5 $\mu g/m^3$	91 $\mu g/m^3$
3-hour Average		0.5 ppm		25 $\mu g/m^3$	512 $\mu g/m^3$
1-hour Average			0.40 ppm[a]		
Carbon Monoxide (CO)					
8-hour Average	9 ppm		9 ppm		
1-hour Average	35 ppm		35 ppm		
Ozone (O_3)					
1-hour Average[b]	0.12 ppm	0.12 ppm	0.12 ppm		
8-hour Average	0.08 ppm				
Nitrogen Dioxide (NO_2)					
Annual Average	0.05 ppm	0.05 ppm	0.05 ppm	1 $\mu g/m^3$	25 $\mu g/m^3$
Lead (Pb)					
Quarterly Average	1.5 $\mu g/m^3$	1.5 $\mu g/m^3$	1.5 $\mu g/m^3$		

µg/m3 = micrograms per cubic meter; ppm = parts per million

Annual standards never to be exceeded; short-term standards not to be exceeded more than once per year unless otherwise noted.

(a) 0.25 not to be exceeded more than twice in seven days

(b) Not to be exceeded on more than 1.0 days per calendar year as determined under the conditions of Chapter 173-475 WAC.

3.1.2.2 New Source Performance Standards

The “new source performance standards” (NSPS) represent a minimum level of emission control that is required for new sources of air pollution. Performance standards for a number of air pollution sources are provided in 40 CFR Part 60. EPA regulates stationary gas turbines in 40 CFR Part 60, Subpart GG which has been adopted by Washington State in WAC 173-400-115. The NSPS for turbines in this classification limit emissions of oxides of nitrogen (NOx) based on heat input. Each of the two proposed combustion turbines would consume 1,675 Million British thermal units per hour (MMBtu/hour) when burning natural gas to generate 181 megawatt (MW) base load at 59 degrees F. The NSPS NOx limits for these turbines is 159 parts per million (ppm).

The NSPS also limit sulfur dioxide (SO2) emissions to 150 ppm, and prohibit the use of fuel containing more than 0.8 percent sulfur (by weight). The NSPS also require continuous monitoring of fuel and water consumption and daily measurements of the sulfur and nitrogen content of natural gas provided by pipeline.

40 CFR Part 60, Subpart Da applies to electric steam generating units with heat input from fuels combusted exceeding 250 MMBtu/hour and would apply to the heat recovery steam generator (HRSG) when the duct burners are operating because the heat input would be approximately 466 MMBtu/hour. Subpart Da limits particulate matter emissions to 0.03 lbs/MMBtu and SO2 and NOx emissions to 0.20 lb/MMBtu. At the proposed firing rate of up to 466 MMBtu/hour, these limits equate to emission rates of 14 pounds of particulate matter per hour, 93 pounds of SO2 per hour, and 93 pounds of NOx per hour.

3.1.2.3 Title 4 (Acid Rain) Provisions

Title 4 of the Clean Air Act Amendments of 1990 provides a strategy for reducing national emissions of nitrogen and sulfur oxides as part of a comprehensive plan for reducing acid deposition. Part 75 requires any gas turbine larger than 25 MW that provides more than one-third of its potential electric output capacity to a utility power distribution system to monitor flow rate, oxygen, and emissions of nitrogen and sulfur oxides. The proposed S2GF would be subject to these requirements.

3.1.2.4 State and Local Emission Limits

As a part of the prevention of significant deterioration (PSD) process, EFSEC is reviewing the applicant’s evaluation of alternative emission control technologies. The “best available control technology” (BACT) analysis identifies pollutant-specific alternatives for emission control, and the costs and benefits of each alternative technology. The determination of which control technology best protects ambient air quality is made on a case-by-case basis and considers the economic, energy, and environmental costs associated with the control technology.

Chapter 173-460 WAC requires that BACT also be used to control emissions of toxic air pollutants. In general, the same technologies or operational parameters that reduce criteria pollutants (for example, the pollutants listed in Table 3.1-1) also reduce toxic air pollutants. For example, the use of natural gas instead of fuel oil reduces emissions of most criteria and toxic air pollutants. The use of combustion controls to optimize combustion also reduces both criteria pollutants (Table 3.1-1) and toxic air pollutants, such as lead, some heavy metals, and some organics. Toxic air pollutants are discussed below in Section 3.1.1.6.

The determination of what constitutes BACT at the time of the final permit review will define the emission limits for the S2GF project. EFSEC has issued PDS permits for projects similar to the S2GF project that indicate two NOx technologies constitute BACT: "advanced" dry low-NOx (ADLN) combustor technology, and Selective Catalytic Reduction (SCR). SCR is a post-combustion NOx control device that uses a catalyst and ammonia to reduce NOx. SCR is capable of reducing NOx emissions to 4.5 ppm or less, but has the negative aspect of releasing unreacted ammonia as an additional pollutant. Given this tradeoff, recent BACT determinations have indicated that either 9 ppm without SCR or 4.5 ppm with SCR is considered BACT.

Largely in response to Canadian concerns about S2GF's potential effect on ozone concentrations in the Lower Fraser Valley and federal land manager concerns about nitrate deposition in Class I areas, the applicant proposes lower NOx emissions from a Westinghouse-based project. SE2 proposes that BACT for NOx emissions from the project is SCR with NOx limits of 3 parts per million dry volume (ppmvd) when firing natural gas and 12 ppmvd when firing oil. The proposed NOx limit when firing gas is 33 percent lower than the 4.5 ppm NOx emission limit for a similar project in Washington State (the Satsop project).

General standards for maximum emissions for air pollution sources in Washington State are outlined in WAC 173-400-040. WAC 173-400-040 limits visible emissions to 20 percent opacity except for three minutes per hour; controls nuisance particulate fallout, fugitive dust, and odors; and limits SO2 emissions to no more than 1000 ppm. WAC 173-400-050 identifies emission standards for combustion and incinerator units, and limits particulate matter emissions to 0.1 grains per dry standard cubic foot at seven percent oxygen (O2). The NWAPA regulations mirror the Department of Ecology's emission limits from new sources.

3.1.2.5 Prevention of Significant Deterioration (PSD)

For major energy facilities in Washington State, EFSEC administers the PSD process. PSD regulations were established by EPA to ensure that new or expanded emission sources do not cause the air quality in areas that currently meet ambient standards to deteriorate significantly. These regulations set "increments" that limit the increases in sulfur dioxide, nitrogen dioxide, and particulate matter concentrations that may be produced by a new source. Increments have been established for three land classifications. The most stringent increments apply to Class I PSD areas, which include wilderness areas and national parks. The Class I area nearest the S2GF site is the North Cascades Wilderness area located about 35 miles (56 km) east of Sumas. The area around the S2GF is designated Class II, where less stringent PSD increments apply. Class I and Class II increments are shown with the ambient standards in Table 3.1-1.

The proposed S2GF project will be subject to PSD regulations because its overall emissions will exceed 100 tons per year of a regulated pollutant. Once subject to the PSD process, emissions of other pollutants that exceed significant emission thresholds must also be considered. Annual emissions of carbon monoxide (CO), NOx, SO2, sulfuric acid mist, volatile organic compounds (VOCs), and particulate matter from the proposed facility could exceed the significant emission rates that trigger evaluation in the PSD permit.

3.1.2.6 Toxic Air Pollutant Regulations

Washington State regulates emissions of toxic and known carcinogenic air pollutants from new and modified air pollution sources (Chapter 173-460 WAC). This regulation establishes acceptable outdoor exposure levels called Acceptable Source Impact Levels (ASILs) for each of more than 500 substances. The ASILs are set conservatively to protect human health. For each "known, probable and potential" human carcinogenic pollutant (the Class A toxic air pollutants), the ASIL limits the risk of an additional cancer case to one in one million. For others (the Class B toxic air pollutants), the ASILs are set by dividing worker exposure limits by 300 which was done to protect public health in a community with multiple sources of toxic air pollutants.

The Washington State regulations (Chapter 173-460 WAC) also require the use of Best Available Control Technology for toxic air pollutants (T-BACT). These regulations require dispersion modeling of the emissions that will occur with BACT and a comparison of ambient concentrations with the ASILs. If calculated concentrations are less than the ASILs, a permit can be granted. If not, the applicant must revise the project or submit a health risk assessment demonstrating that toxic emissions from the source are sufficiently low to protect human health. For carcinogenic pollutants, the risk of an additional cancer case cannot exceed one in one hundred thousand (Chapter 173-460-090(b)(3) WAC).

3.1.2.7 Notice of Construction and Application for Approval

Washington State requires a Notice of Construction (NOC) for new air contaminant sources (WAC 173-400-110). The NWAPA has a similar requirement for new or modified sources within its jurisdiction. The NOC application requires a description of the facility and an inventory of pollutant emissions and controls. The reviewing agency considers whether BACT has been employed and evaluates ambient concentrations resulting from these emissions to ensure compliance with ambient air quality standards.

After the S2GF facility is constructed, it would be inspected to ensure that it complies with the plans and specifications submitted with the NOC and may include tests to determine the actual emissions from the facility. After a satisfactory inspection, the source is registered and written permission to operate is granted.

3.1.3 Existing Air Quality

The NWAPA maintains air quality monitoring stations in Whatcom and Skagit Counties. In general, these stations are located where there may be air quality problems, and so are usually in or near urban areas or close to specific large air pollution sources. Within the NWAPA's jurisdiction, these stations are located in Bellingham, Anacortes, and at March Point.

The Department of Ecology and EPA designate regions as being "attainment" or "nonattainment" areas for particular air pollutants based on monitoring information collected over a period of years. Attainment status is a measure of whether air quality in an area complies with the health-based ambient air quality standards. Whatcom County is in attainment for all air pollutants, and is generally considered to have good air quality.

The GVRD operates air quality monitoring stations in the Lower Fraser Valley, including a station in Abbotsford, B.C. The GRVD station collects data that are considered more representative of ambient air quality near the proposed S2GF site than the NWAPA stations.

The monitoring data collected in Abbotsford from 1996 through 1998 have been used to characterize existing air quality at the S2GF site. A summary of these data is presented in Table 3.1-2 based on GVRD annual reports (GRVD 1998) and data obtained from the British Columbia MELP.

With the exception of ozone and inhalable particulate matter (PM10), observed pollutant concentrations at Abbotsford are lower than the most stringent Canadian objectives and applicable National Ambient Air Quality Standards (NAAQS) and Washington Ambient Air Quality Standards (WAAQS). From 1996 to 1998, the maximum hourly ozone concentrations at the Abbotsford airport were about 60 percent of the 1-hour NAAQS, but exceeded short-term Canadian Desirable Objectives.

Observations of vehicle-related and other mobile-source related pollutants, including NO2 and CO concentrations, were less than one-third of the NAAQS. The data in Table 3.1-2 also indicate that industrial sources do not contribute significant amounts of SO2 in the area.

PM10 concentrations associated with wood smoke, fugitive dust, secondary aerosols, and combustion sources were also lower than the NAAQS, but PM10 sometimes exceeds the 24-hour GVRD Interim Objective. Since PM10 monitoring started in Abbotsford in the spring of 1992, up to four daily-average concentrations per year have exceeded 50 micrograms per cubic meter ($\mu g/m^3$).

Table 3.1-2: Summary of Air Quality Data for Abbotsford, B.C. Monitoring Station (1996-1998)

Averaging Period (hours)	Abbotsford Maximum Concentration (μg/m^3)			1996-1998 Average Max (μg/m^3)	More Stringent of the Canada or B.C. Air Quality Objectives Desirable Levels (μg/m^3) (a)	More Stringent of the NAAQS or WAAQS (μg/m^3)
	1996	1997	1998			
SO2						
1	32	29	51	37	450	1,050
3	27	24	34	28	375	1,300
24	10	7	11	9	150	262
Annual	2	2	3	2	25	52
NO2						
1	120	113	117	117	400(b)	None
24	63	63	62	62	200(b)	None
Annual	32	34	33	33	60	100
NO						
24	143	144	109	132	None	None
Annual	24	29	20	24	None	None
CO						
1	6,867	7,333	9,094	7,760	14,300	40,000
8	3,841	3,419	2,998	3,419	5,500	10,000
PM10						
24	62	44	66	57	50(c)	150
Annual	15	16	16	16	30(c)	50
Ozone						
1	156	136	158	150	100	235
24	82	66	70	73	30	None
Annual	28	25	29	28	30(b)	None

(a) Maximum desirable levels unless indicated. Objectives are goals, not standards.

(b) Maximum acceptable level (maximum desirable level has not been established).

(c) Interim objective.

PM10 observations in Abbotsford above the GVRD Interim Objective have been attributed to windblown dust during high wind events (British Columbia MELP 1997) and a local source near the monitoring site (GVRD 1998).

3.1.4 Environmental Impacts of Proposed Action

3.1.4.1 Construction

Construction of the generation plant, the natural gas pipeline, water and wastewater lines, and the electric transmission lines would generate air pollutants. Air quality impacts associated with the gas pipeline, water lines, and transmissions lines are expected to be minimal because relatively little equipment would be required and the construction period would be relatively short.

Construction of the generation plant would be more concentrated and prolonged, but offsite air quality impacts are likely to be slight. Because the site is fairly flat, there would be relatively little grading of the site prior to construction. Fill material brought to the site would not be expected to be a significant source of dust. Fill material would be spread over the site and compacted. In the event the material was dusty, it could be watered to increase the moisture content. Therefore, dust generated by excavation and grading activities would be short-term and limited to the duration of construction activity.

Some of the machinery (compressors, generators, etc.) and heavy equipment (loaders, dozers, trucks, etc.) used to construct the facility would be powered by internal combustion engines. These engines emit products of combustion, but offsite air quality impacts would be negligible.

Construction of the generation plant would also include some activities that would potentially generate odors. If oil-based paints are applied to structures or equipment at the site, paint odors may be perceptible nearby. Some of the site would be paved with asphalt, and asphalt fumes may be perceptible for a short period during the paving operation. These impacts are expected to be slight and of short duration.

3.1.4.2 Operation

Emission Rates

The proposed facility would be composed of two combustion turbines manufactured by Siemens-Westinghouse (Westinghouse). Each of the combustion turbines would be paired with a Heat Recovery Steam Generator (HRSG). Each HRSG would be designed for duct firing, which would allow additional heat generation when economically beneficial. Although the gas turbines would be configured to fire very low sulfur (0.05 percent or less) distillate oil, the duct burners would only be fired with natural gas. The proposed facility would only fire distillate oil during periods when there is a high external demand for natural gas (such as during very cold spells), and then for no more than 15 days per year.

The use of combustion turbines with HRSGs to generate electricity has become an efficient means of generating electricity. Natural gas has been selected as the base operating fuel, in part to minimize air pollution emissions. Natural gas combustion results in lower emissions of NOx, SO2, CO, carbon dioxide (CO2), particulate matter, and unburned hydrocarbons than does combustion of other fossil fuels.

During normal operations, the turbines would be fired by natural gas. Supplemental duct firing with low NOx burners at a rate of 466 MMBtu/hour would be used for additional peaking demand, especially during the summer months. Although natural gas has been selected as the base operating fuel, the project must provide for oil firing during periods of possible gas shortage. Historical gas shortage during the winter months has been limited to a few days or has not been required during mild winters. The applicant's design includes 15 days of potential oil firing during the winter months of December through February.

Table 3.1-3 summarizes emission rates under four operating scenarios for the S2GF based on vendor-provided information and proposed BACT limits. The four operating scenarios evaluated include:

- Partial Load Fired by Gas. This scenario provides emissions for turbines operating at 70 percent of base load. A 70 percent partial load is considered the minimally efficient operating rate and is also representative of startup and shutdown conditions. In general, emissions of most pollutants are lower at partial load because the fuel rate and combustion temperatures are lower. Although short-term emissions are lower, this scenario is used in the modeling analyses because there is less plume rise and a relatively greater potential for high ground-level concentrations.

- Base Load Fired by Gas. This operating scenario represents normal operating conditions expected at the proposed S2GF.

- Base Load Supplemented with Duct Firing. This scenario provides for maximum power production and associated emissions when the turbines are fired by natural gas.

- Base Load Fired by Oil. This scenario provides for oil firing up to 15 days per year during the winter months.

Table 3.1-4 compares anticipated emissions of PSD pollutants with the levels of such pollutants which have been established as the threshold criteria where increment consumption becomes an issue of concern. The minimum emission rate (in tons per year) which triggers a PSD review is referred to as the significant emission rate. Comparison of the maximum anticipated emissions with applicable criteria indicates that the proposed facility has the potential for significant emissions of six pollutants.

Table 3.1-3: Combustion Turbine Emission Rates for S2GF, Westinghouse 501f Combustion Turbines with Selective Catalytic Reduction and Oxidation Catalyst

Pollutant	Short-term Emissions per Turbine (lb/hr)				Annual Emissions Both Turbines(tpy)
	Partial Load	Base Load	With Duct Firing	Base with Oil Firing	
NOx	15.0	19.7	24.7	79.3	236
CO	6.1	8.0	10.0	48.3	101
SO2	0.8	1.1	1.5	90.2	45
VOC	5.1	3.5	17.5	24.7	156
PM10	16.0	19.1	23.8	63.6	223
CO2	162,000	213,000	276,000	284,000	2,420,000

Notes:

Annual emissions in tons per year (tpy) based on 15 days of oil firing and 350 days with duct firing.

SO2 emissions based on 0.2 grains of sulfur per 100 standard cubic feet (SCF) for gas and 0.05% sulfur in oil.

Emission rates for all cases based on 59°F ambient temperature and 60% relative humidity.

Table 3.1-4: Comparison of Anticipated Emissions from S2GF with Significant Emission Rates

Pollutant	Significant Emission Rate (tpy)	Anticipated Emissions (tpy)	Significant?
CO	100	101	Yes
NOx	40	236	Yes
SO2	40	45	Yes
PM10	25	223	Yes
Ozone (VOC)	40 (of VOCs)	156	Yes
Lead	0.6	0.01	No
Fluoride	0.3	None	No
Sulfuric Acid Mist	7	7.9	Yes

Emissions in tons per year (tpy) based on 15 days of oil firing and 350 days with duct firing.

Toxic Air Pollutant Emission Rates

The S2GF has the potential to emit small quantities of toxic air pollutants, including formaldehyde, benzene, and other organic compounds associated with the combustion of fossil fuels. In addition, post-combustion NOx control with selective catalytic reduction (SCR) results in ammonia emissions or ammonia "slip."

Toxic pollutant emission rates were estimated using a recently compiled database for the EPA (Alpha-Gamma Technologies 1998). The database contains emission factors for a wide range of turbine vendors, fuels, operating loads, and turbine sizes. The toxic pollutant emission factors and emission rates for the gas and oil turbine options used in the impact analysis are shown in Table 3.1-5 and in Table 3.1-6, respectively.

Table 3.1-5: Toxic Air Pollutant Emission Factors and Rates for S2GF with Gas Firing

Toxic Air Pollutant	Emission Factor (lb/MMSCF)	Short-term Emissions per Turbine (lb/hr)		
		Partial Load	Base Load	With Duct Firing
Acrolein	0.0079	0.0115	0.0153	0.0198
Ammonia	See below	18.5	24.3	31.8
Ethylbenzene	0.024	0.0349	0.0464	0.0602
Naphthalene	0.14	0.204	0.271	0.351
Sulfuric Acid Mist	See below	0.0753	0.104	0.141
Toluene	0.13	0.189	0.251	0.326
Xylenes (m-,o-,p-isomers)	0.027	0.0393	0.0522	0.0678
Mercury	0.00044	0.0006	0.0009	0.0011
Acetaldehyde	0.08	0.116	0.155	0.201
Benzene	0.14	0.204	0.271	0.351
Formaldehyde	0.01	0.0146	0.0193	0.0251
PAHs	0.00081	0.0012	0.0016	0.002
Arsenic	0.00005	0.0001	0.0001	0.0001

Notes:

Emission factor presented in pounds per million cubic feet (lb/MMSCF).

Ammonia emissions based on 10 ppmvd (15% O_2).

Sulfuric acid mist based on 6% conversion of SO_2 in the turbine and 8% conversion of remaining SO_2 in the HRSG.

Source: Alpha-Gamma Technologies, Inc. *Emission Factor Documentation for AP-42 Section 3.1 Stationary Gas Turbines*. USEPA, Research Triangle Park, NC, May 1998.

Table 3.1-6: Toxic Air Pollutant Emission Factors and Rates for S2GF With Oil Firing

Toxic Air Pollutant	Emission Factor (lb/1000 gal)	Short-term Emission Rates Per Turbine (lb/hr)
Ammonia	See below	24.9
Chromium	0.00094	0.0120
Lead	0.0015	0.0192
Manganese	0.06	0.767
Mercury	0.000087	0.0011
Naphthalene	0.0043	0.0549
Selenium	0.0032	0.0409
Sulfuric Acid Mist	See below	18.7
Acetaldehyde	0.0043	0.0549
Arsenic	0.0011	0.0141
Benzene	0.0076	0.0971
Beryllium	0.000046	0.0006
Cadmium	0.00045	0.0057
Chromium VI	0.000012	0.0002
Dioxins	4.70E-08	6.00E-07
Formaldehyde	0.032	0.409
Furans	1.30E-07	1.66E-06
Nickel	0.012	0.153

Ammonia emissions based on 10 ppmvd (15% O_2).

Sulfuric acid mist based on 6% conversion of SO_2 in the turbine and 8% conversion of remaining SO_2 in the HRSG.

Source: Alpha-Gamma Technologies, Inc. *Emission Factor Documentation for AP-42 Section 3.1 Stationary Gas Turbines*. USEPA, Research Triangle Park, NC, May 1998.

Air Quality Impact Assessment

An air quality impact assessment was conducted for the proposed S2GF project based on five years of meteorological data from the Abbotsford Airport in British Columbia. Computer-based modeling techniques were used to simulate dispersion of air emissions from the proposed facility.

The modeling simulated the dispersion of criteria and toxic pollutant releases from the proposed facility to assess compliance with ambient standards, Department of Ecology Acceptable Source Impact Levels (ASILs) for toxic pollutants, and Class I and Class II

PSD increments. Because the modeling region includes portions of British Columbia, estimated emissions were also compared to Canadian Air Quality Objectives.

Modeling techniques used in the analysis follow EPA regulatory guidelines (40 CFR Part 51, Appendix W). The guidelines include recommendations for model selection and data preparation. To achieve consensus on modeling issues prior to the impact assessment and to address the need for a pre-construction air quality monitoring program, a preliminary modeling analysis was submitted for review to EFSEC and the Department of Ecology (MFG 1998). The Department of Ecology accepted the findings of the preliminary analysis and pre-construction monitoring was not required for the proposed project.

The air quality analysis was based on the maximum emissions that would occur for the S2GF with gas and oil firing after the application of BACT. Therefore, estimated concentrations for averaging periods of 24 hours or less were based on oil firing, which could occur up to 15 days per year. Estimated annual average concentrations were based on the assumption that oil firing would occur for 15 days, and gas firing at base load supplemented by duct firing would occur over the remaining 350 days. The assumptions of maximum oil firing, maximum capacity generation, and continuous operation results in a conservative impact assessment.

Ambient Air Quality Standards Impact Assessment

This section compares estimated pollutant concentrations attributable to the S2GF with NAAQS and WAAQS established by the EPA and the Department of Ecology, respectively, and to the most stringent of the Canadian Air Quality Objectives. As shown in Table 3.1-7, when the maximum predicted concentrations from the S2GF project are added to the highest monitored values from the Abbotsford Airport, total concentrations are less than the applicable WAAQS or NAAQS.

Table 3.1-7 also indicates that the interim GVRD Maximum Acceptable Objective for 24-hour PM10 could be exceeded during periods of oil firing. High PM10 observations at the Abbotsford Airport have historically been associated with high wind and windblown dust from agricultural areas and exposed soils in the eastern portion of the Lower Fraser Valley. Although such events can occur during the winter, those meteorological conditions are different than those that produce high PM10 concentrations from the oil-fired turbines. The maximum concentrations from the S2GF facility would occur with light winds and stable atmospheric conditions. As a result, it is unlikely that the proposed facility would contribute to or cause PM10 concentrations above the interim GVRD 24-hour Maximum Acceptable Objective.

Table 3.1-7: Comparison of S2GF Emissions with Applicable Ambient Air Quality Standards

Averaging Period (hours)	Maximum Concentrations ($\mu g/m^3$)			More Stringent of the Canada or British Columbia Air Quality Objectives ($\mu g/m^3$)	More Stringent of the WAAQS or NAAQS ($\mu g/m^3$)
	Proposed Project (a,b)	Background	Total		
SO2					
1	72	37	109	450	1,050
3	52	28	80	375	1,300
24	14	9	23	150	262
Annual	0.1	2	2	25	52
NO2(c)					
1	64	117	181	400	None
24	13	62	75	200	None
Annual	0.5	33	34	60	100
CO					
1	39	7,760	7,799	14,300	40,000
8	20	3,419	3,439	5,500	10,000
PM10					
24	10 (d)	57	67 (d)	50	150
Annual	0.48	16	16	30	50

(a) Short-term maximum prediction of four operating scenarios and five years of meteorological data. Annual concentrations based on 15 days of oil firing and 350 days gas firing with supplemental duct firing.

(b) Includes those receptors where project source contributions are significant. The criteria for significant contributions used are the EPA SILs for SO2 and PM10, 8 $\mu g/m^3$ for 1-hour NO2, and 4 $\mu g/m^3$ for 24-hour NO2 concentrations. The last two significance levels are based on 2% of the Canadian Desirable Objectives.

(c) NOx is assumed to be fully converted to NO2.

(d) The highest PM10 prediction in Canada is 7 $\mu g/m^3$ from project sources. The highest cumulative concentration in Canada is 64 $\mu g/m^3$.

Prevention of Significant Deterioration (PSD) Analysis

The S2GF project would be subject to PSD requirements, a permitting program established by the EPA to ensure that new or expanded sources of air pollution do not cause significant deterioration of air quality in areas that currently meet the standards. The PSD regulations set “increments,” which limit the increases in SO2, NO2, and particulate matter concentrations that may be produced by new sources. The magnitude of the allowable increments depends on an area’s classification. The most stringent increments apply to Class I PSD areas, which include wilderness areas and national parks. The Class I area nearest to the project site is the North Cascades National Park, located about 35 miles (56 km) east of Sumas. The immediate vicinity of the project site is a Class II area where less stringent increments apply. PSD increments are shown in Table 3.1-1.

This section evaluates whether the S2GF would comply with the Class II and Class I PSD increments. The analysis compares PSD contributions from the S2GF to the applicable increments and includes other increment consuming sources when appropriate.

Class II PSD Increments. As shown in Table 3.1-8, preliminary analysis has indicated that estimated 24-hour SO2, 3-hour SO2, and 24-hour PM10 concentrations could exceed significant impact levels (SILs) during periods of oil-firing. The impact on Class II PSD increments was determined by totaling the contributions from increment consuming industrial sources within a radius of influence surrounding the S2GF. The EPA defines the "radius of influence" as the farthest distance from the S2GF, not to exceed 31 miles (50 km) where the estimated concentrations exceed the SIL. Dispersion modeling indicates that the radius of influence is 10 km and 12 km, for PM10 and SO2 concentrations, respectively. Based on the Department of Ecology's emission inventory for 1997 and 1998 emission data for the SCCL, the industrial sources listed in Table 3.1-9 were included in the PSD analysis.

Table 3.1 –8: Maximum Short-Term Criteria Pollutant Predictions for S2GF

Pollutant	Averaging Time	Maximum S2GF Concentration (µg/m3)				SIL (µg/m3)
		Gas-Fired Partial Load	Gas-Fired Base Load	Gas-Fired Base Load w/Duct Firing	Oil-Fired Base Load	
NO2 (a)	1 hour	14.7	18.7	23.6	63.6	(b)
	24 hour	2.98	3.76	4.73	12.6	(c)
SO2	1 hour	0.78	1.04	1.43	72.4	(d)
	3 hour	0.59	0.80	1.09	51.5	25
	24 hour	0.16	0.21	0.29	14.3	5
CO	1 hour	5.97	7.59	9.56	38.7	2,000
	8 hour	3.03	3.92	4.92	19.8	500
PM10	24 hour	3.18	3.64	4.56	10.1	5

(a) NOx is conservatively assumed to be fully converted to NO2.

(b) SIL has not been established. Canadian Air Quality Objective, Maximum Acceptable Level is 400 µg/m3.

(c) SIL has not been established. Canadian Air Quality Objective, Maximum Acceptable Level is 200 µg/m3.

(d) SIL has not been established. WAAQS is 1,050 µg/m3.

Table 3.1-9: Increment Consuming Industrial Sources within 20 km of S2GF Site

No.	Plant Name	Source	Maximum Short-term Emission Rate (lb/hr)	
			PM10	SO2
1	Great Western Lumber	Cyclones	2.88	0.00
2	Great Western Lumber	Fugitive Dust	1.89	0.00
3	Wilder Construction	Pole Road Asphalt Plant – Singer Pit	1.25	0.45
4	Northwest Pipeline	Natural Gas Turbine Unit 7	1.37	0.00
5	Northwest Pipeline	Natural Gas Turbine Unit 8	1.14	0.23
6	Sumas Cogeneration	GE MS-7000EA Gas Turbine	1.83	2.06
7	IKO	Combustion Sources Combined	0.71	2.48
8	IKO	Baghouses	10.70	0.00
9	IKO	Mist Eliminator	3.42	0.00
10	IKO	Oxidizer/Blowing Still	3.00	0.00

Notes: PSD increment consuming sources within Whatcom County from data obtained from Ecology. With the exception of the Sumas Cogeneration Plant (SCCLP), the emission rates shown are from the 1997 inventory, the latest inventory available from Ecology. Emissions from SCCLP are based on the 1998 inventory submitted to NWAPA.

Table 3.1-10 summarizes the Class II increment analysis. For all criteria pollutants, cumulative concentrations are below the applicable Class II PSD increments and would likely be lower since the turbines would only be fired by oil during periods of gas shortage.

Class I PSD Increments. Class I areas within approximately 109 miles (175 km) of the S2GF facility were evaluated to assess the contribution of project-related emissions to Class I increments. The Class I area closest to the S2GF site is the North Cascades National Park, approximately 34 miles (55 km) east of the facility. Other Class I areas within approximately 109 miles (175 km) of the proposed facility include Pasayten Wilderness, Glacier Peak Wilderness, Alpine Lakes Wilderness, and the Olympic National Park.

Modeling procedures used to evaluate impacts to Class I areas were based on the Interagency Workgroup on Air Quality Modeling (IWAQM) recommendations for modeling long range transport (IWAQM 1993). The results of the Class I analysis are shown in Table 3.1-11 for the four operating scenarios described earlier.

Table 3.1-10: Class II Increment Analysis for S2GF

Criteria Pollutant	Averaging Time	Maximum Concentration (μg/m³)		Class II PSD Increment (μg/m³)
		S2GF Sources	All Increment Consuming With Project (b)	
NO2 (a)	Annual	0.5	(c)	25
SO2	3-hour	51.5	53.8	512
	24-hour	14.3	14.9	91
	Annual	0.1	(c)	20
PM10	24-hour	10.1	12.4	30
	Annual	0.5	(c)	17

(a) NOx is assumed to be fully converted to NO2.

(b) Maximum combined prediction at receptors where project-related concentrations are significant (above the SILs).

(c) Project-related maximum concentrations are not significant; not necessary to consider other increment consuming sources.

Table 3.1-11: Class I Increment Analysis for S2GF

Pollutant	Period (b)	Maximum Prediction for S2GF Sources (μg/m³)					Class I Increment (μg/m³)
		Gas-Fired Partial Load	Gas-Fired Base Load	Gas-Fired With Duct Firing	Oil-Fired Base Load	Total or Max.	
NO2 (a)	Annual			0.026	0.006	0.032	2.5
SO2	Annual			0.002	0.007	0.008	2
	24-hour	0.010	0.014	0.019	0.800	0.800	5
	3-hour	0.045	0.056	0.079	2.384	2.384	25
PM10	Annual			0.025	0.005	0.030	4
	24-hour	0.204	0.235	0.297	0.564	0.564	8

(a) NOx emitted is assumed to be fully converted to NO2.

(b) Annual concentrations based on 15 days of oil firing and 350 days gas-firing with supplemental duct firing.

The modeling results indicate that the S2GF facility by itself would comply with Class I PSD increments. The highest short-term concentrations would occur in the North Cascades and Olympic National Parks during periods of oil firing, while the highest annual concentrations are predicted for the Olympic National Park. The highest 24-hour concentrations would occur with oil-firing in the North Cascades National Park on days with light to moderate westerly winds. Such conditions at the site are infrequent, especially during the winter. Annual concentrations in the North Cascades National Park and other Class I areas are less than the Olympic National Park. The maximum annual predictions in the Olympic National Park are the result of the frequent northeasterly winds observed at the S2GF site, especially during the winter months when oil firing is possible.

In addition, dispersion modeling was conducted that included other industrial sources (i.e., the S2GF and other existing industrial sources) within approximately 12 miles (20 km) of the proposed facility. Since these sources are located relatively close to one another, they would tend to influence the Class I areas at the same time as the emissions from the S2GF. Results of the cumulative impact analysis are shown in Table 3.1-12. Model results indicate that Class I increments would not be exceeded during oil firing when combined with concentrations from other industrial sources within 12 miles (20 km) of the proposed facility.

Table 3.1-12: Results of Class I Increment Analysis for S2GF Cumulative Impacts and Other Industrial Sources within 12 miles (20 km)

Pollutant	Period (b)	Maximum Prediction ($\mu g/m^3$)		Class I Increment ($\mu g/m^3$)
		S2GF	All Sources	
NO2(a)	Annual	0.032	(c)	2.5
SO2	Annual	0.008	(c)	2
	24-hour	0.800	0.816	5
	3-hour	2.384	2.612	25
PM10	Annual	0.030	(c)	4
	24-hour	0.564	0.698	8

(a) NOx emitted is assumed to be fully converted to NO2.

(b) Annual concentrations based on 15 days of oil firing and 350 days gas-firing with supplemental duct firing.

(c) Project-related maximum concentrations not significant; not necessary to consider other increment consuming sources.

Toxic Air Pollutant Analysis

Dispersion modeling for toxic air pollutants was conducted using the same methods as described for the criteria pollutants. Maximum 24-hour and annual toxic air pollutant concentrations attributable to the proposed facility and comparisons to Department of Ecology ASILs are shown in Tables 3.1-13 and 3.1-14, respectively. The 24-hour maximum and annual predictions are all less than the Department of Ecology ASILs under all operating scenarios.

Table 3.1-13: Maximum Short-Term Toxic Pollutant Predictions for S2GF

Pollutant	Maximum 24-hour Concentrations ($\mu g/m^3$)				24-hour Ecology ASIL ($\mu g/m^3$)
	Gas-Fired Partial Load	Gas-Fired Base Load	Gas-Fired With Duct Firing	Oil-Fired Base Load	
Acrolein	0.0023	0.0029	0.0038	Nd	0.02
Ammonia	3.67	4.64	6.10	3.94	100
Chromium	Nd	Nd	Nd	0.0019	1.7
Ethylbenzene	0.0069	0.0088	0.0115	Nd	1000
Lead	Nd	Nd	Nd	0.0030	0.5
Manganese	Nd	Nd	Nd	0.122	0.4
Mercury	0.0001	0.0002	0.0002	0.0002	0.17
Naphthalene	0.0404	0.0516	0.0673	0.0087	170
Selenium	Nd	Nd	Nd	0.0065	0.67
Sulfuric Acid Mist	0.0149	0.0197	0.0270	2.96	3.3
Toluene	0.0376	0.0479	0.0625	Nd	400
Xylenes	0.0078	0.0099	0.0130	Nd	1500

Note: Nd refers to no data, or stack test results less than the method detection limit.

Table 3.1-14: Annual Toxic Air Pollutant Concentrations for S2GF

Pollutant	Maximum Annual Concentration ($\mu g/m^3$) (a, b)			Annual Ecology ASIL ($\mu g/m^3$)
	Gas-Fired With Duct Firing	Base Load Oil-Fired	Total	
Acetaldehyde	3.65E-03	4.86E-05	3.70E-03	4.50E-01
Arsenic	2.23E-06	1.24E-05	1.47E-05	2.30E-04
Benzene	6.38E-03	8.59E-05	6.47E-03	1.20E-01
Beryllium	Nd	5.20E-07	5.20E-07	4.20E-04
Cadmium	Nd	5.09E-06	5.09E-06	5.60E-04
Chromium VI	Nd	1.36E-07	1.36E-07	8.30E-05
Dioxins	Nd	5.31E-10	5.31E-10	3.00E-08
Formaldehyde	4.56E-04	3.62E-04	8.18E-04	7.70E-02
Furans	Nd	1.47E-09	1.47E-09	3.00E-08
Nickel	Nd	1.36E-04	1.36E-04	2.10E-03
PAHs	3.71E-05	Nd	3.71E-05	4.80E-04

Note: Nd refers to no data, or stack test results less than the method detection limit.

(a) Annual concentrations based on 15 days of oil firing and 350 days gas-firing with supplemental duct burners.

(b) Units are expressed in scientific notation in exponential form (e.g., 3.65E-03 = 0.00365).

Assessment of Air Quality Related Values for Class I Areas

As the federal land managers for the Class I areas, the National Park Service (NPS) and U.S. Forest Service (USFS) have the responsibility for ensuring that air quality related values (AQRVs) in the Class I areas are not adversely affected, regardless of whether the Class I increments are maintained.

AQRVs include regional visibility or haze; the effects of primary and secondary pollutants on sensitive plants; the effects of pollutant deposition on soils and receiving water bodies; and other effects associated with secondary aerosol formation. An extensive regional modeling analysis based on the CALMET/CALPUFF modeling system was conducted to provide estimates of secondary aerosol formation, deposition flux, and extinction coefficients for visual range.

AQRV Modeling Procedures. Dispersion modeling used to assess Class I AQRVs followed guidelines for refined analyses outlined in the *Phase 2 Summary Report and Recommendations for Modeling Long Range Transport Impacts* (IWAQM 1998). The analysis applied the CALPUFF modeling system and Pacific Northwest regional meteorology to assess secondary aerosol formation, nitrogen deposition, sulfur deposition, and regional haze. The modeling procedures used in the AQRV analysis were described in a protocol reviewed and approved by the Department of Ecology, NPS, USFS, and the British Columbia MELP prior to the modeling effort.

The CALPUFF system contains many modeling components that are more realistic than the screening procedures used to assess the PSD Class I, PSD Class II, and ambient air quality standards.

Vegetation, Soils, and Aquatic Resources. The impacts of emissions from the S2GF on soils and vegetation in Class I areas were evaluated by comparing estimated concentrations and deposition fluxes with criteria specified by the USFS in *Guidelines for Evaluating Air Pollution Impacts on Class I Wilderness Areas in the Pacific Northwest* (USFS 1992).

Table 3.1-15 shows the highest estimated annual and 24-hour average SO2 and NOx concentrations for the Class I areas. The highest annual and 24-hour concentrations occur in the North Cascades National Park, followed by the Pasayten Wilderness. These Class I areas are east of the S2GF and relatively closer to the site. The higher concentrations occur near the Canadian border as the turbine plumes initially released into the Lower Fraser Valley are transported toward the mountains by the prevailing westerly winds. In several instances the turbine plumes also follow the Nooksack River Valley toward the lower elevations of the North Cascades National Park. For both SO2 and NOx, the highest 24-hour concentrations occur when the turbines are fired by oil during the winter.

To protect plant species, the USFS recommends that maximum SO2 concentrations not exceed 40 to 50 parts per billion (ppb; 105 to 130 $\mu g/m^3$), and that annual SO2 concentrations not exceed 8 to 12 ppb (21 to 31 $\mu g/m^3$). Lichens and bryophytes are found in the subalpine and alpine regions of several of the Class I areas. Some of these species can be sensitive to SO2 concentrations in the range of 5 to 15 ppb (13 to 39 $\mu g/m^3$) (USFS 1992). The USFS also indicates that no significant amount of injury to plant species in the Pacific Northwest is expected for annual NO2 concentrations less than 15 ppb (28 $\mu g/m^3$).

As shown in Table 3.1-15, the 24-hour maximum and annual estimates for the S2GF are less than the USFS criteria established to protect vegetation in Pacific Northwest Class I areas.

Table 3.1-15: Maximum Predicted SO2 and NOx Concentrations in Class I Areas from S2GF

Class I Area	Maximum Annual Concentration (a)		Maximum 24-Hour Concentration (b)	
	NOx ($\mu g/m^3$)	SO2 ($\mu g/m^3$)	NOx ($\mu g/m^3$)	SO2 ($\mu g/m^3$)
Olympic National Park	0.00045	0.00015	0.0526	0.0601
Alpine Lakes Wilderness	0.00015	0.00005	0.0099	0.0238
Glacier Peak Wilderness	0.00030	0.00006	0.0180	0.0145
North Cascades National Park	0.00192	0.00033	0.1360	0.1272
Pasayten Wilderness	0.00105	0.00019	0.0983	0.0893
Maximum Class I Areas	0.00192	0.00033	0.1360	0.1272
U.S. Forest Service Criterion	28	21-31	(c)	105-130
Mt. Baker Wilderness (d)	0.00308	0.00045	0.1486	0.1476

(a) Annual concentrations based on 15 days of oil firing and 350 days gas-firing with supplemental duct firing.

(b) Higher of the gas-fired (with duct burners) and oil-fired predictions.

(c) No criteria identified.

(d) Mt. Baker Wilderness is not a Class I area. Predictions provided for information only.

Soils and aquatic resources in Class I areas can be influenced by nitrogen and sulfur deposition. Nitrogen and sulfur deposition occur through both wet and dry processes. Direct emissions and secondary aerosols formed during transport from the source to the Class I area can contribute to total deposition. Table 3.1-16 compares background Class I area deposition fluxes obtained from the USFS and NPS for each Class I area to deposition criteria established to protect soils and aquatic resources. The USFS indicates that annual sulfur deposition fluxes below 3 kilogram per hectare per year (kg/ha/yr) are unlikely to significantly affect terrestrial ecosystems in Pacific Northwest forests. The USFS also suggests that total nitrogen deposition below 5 kg/ha/yr should cause no injury, and a rate of 3-20 kg/ha/yr has the potential for some injury to plants and forest ecosystems. The background data in Table 3.1-16 suggest that soils and aquatic resources in the Class I areas are currently receiving nitrogen and sulfur deposition at rates near, or in excess of criteria established to protect these areas.

Table 3.1-16: Background Nitrogen and Sulfur Deposition in Class I Areas

Class I Area	Total Nitrogen Deposition (kg/ha/year)	Total Sulfur Deposition (kg/ha/year)
North Cascades National Park	4.1	3.7
Olympic National Park	4.1	3.7
Glacier Peak Wilderness	5.8	8.0
Alpine Lakes Wilderness	5.2	7.2
Pasayten Wilderness	5.2	7.2
USFS/NPS Criteria	5.0	3.0

Note:

Background fluxes for USFS areas provided by USFS in May 1999. These data are taken from the upper limits suggested for these areas by Peterson, J., et al, 1992: *Guidelines for Evaluating Air Pollution Impacts on Class I Areas in the Pacific Northwest.* USDA Forest Service, General Technical Report PNW-GTR-299, May 1992.

National Park data based on 1993-1997 monitoring data collected at Marblemount as suggested by the NPS in its May 14, 1999 letter to the Dept. of Ecology. The NPS did not provide data for Olympic National Park. Annual background deposition for the two national parks is assumed to be the same.

For all areas, total background deposition is conservatively assumed to be double the measured wet deposition flux to account for additional dry and occult (cloud water) deposition processes.

The CALPUFF modeling system was used to estimate S2GF contributions to total nitrogen and sulfur deposition in the Class I areas. The maximum annual deposition fluxes predicted by the CALPUFF modeling system are shown in Table 3.1-17 for each Class I area. S2GF emissions are not expected to contribute significantly to existing nitrogen or sulfur deposition in Class I areas. Deposition fluxes attributable to the project are much less than the USFS criteria and existing background levels. During negotiation of the modeling protocol, the Department of Ecology suggested that significance levels be set at 0.1 percent of the USFS criteria to indicate no significant project contribution, and at 0.1 percent to 2 percent to indicate some concern. The maximum project-related contributions are 0.03 percent of the criteria for annual sulfur and nitrogen deposition.

Table 3.1-17: Maximum Annual Deposition Fluxes to Class I Areas from S2GF

Class I Area	Maximum Annual Sulfur (a) Deposition Flux (kg/ha/yr)			Maximum Annual Nitrogen (a) Deposition Flux (kg/ha/yr)		
	Dry	Wet	Total (c)	Dry	Wet	Total (c)
Olympic National Park	8.24E-05	1.34E-05	9.40E-05	6.93E-05	4.14E-05	1.05E-04
Alpine Lakes Wilderness	2.76E-05	4.31E-05	7.04E-05	8.01E-05	1.59E-04	2.37E-04
Glacier Peak Wilderness	4.20E-05	6.89E-05	1.11E-04	1.62E-04	2.28E-04	3.90E-04
North Cascades National Park	2.01E-04	5.59E-04	7.60E-04	8.18E-04	5.60E-04	1.38E-03
Pasayten Wilderness	9.72E-05	2.71E-04	3.68E-04	3.61E-04	2.67E-04	6.28E-04
Maximum Class I Areas			0.0008			0.0014
USFS/NPS Criteria			3.0			5.0
Mt. Baker Wilderness (b)	3.12E-04	8.20E-04	1.13E-03	1.35E-03	6.97E-04	2.05E-03

(a) Annual concentrations based on 15 days of oil firing and 350 days gas-firing with supplemental duct firing.

(b) Mt. Baker is not a Class I area. Estimates provided for information only.

(c) The maximum wet, dry and total deposition fluxes may occur at different receptors within the Class I area. Thus the maximum total may not equal the sum of the maximum wet and maximum dry deposition flux.

Units are expressed in scientific notation in exponential form (e.g., 3.65E-03 = 0.00365).

Although existing background levels may be of concern, the S2GF would not significantly add to nitrogen or sulfur deposition in the Class I areas.

Regional Haze Assessment. The potential for emissions from the proposed project to contribute to regional haze in Class I areas was evaluated using the CALPUFF modeling system. The analysis assessed the potential for direct fine particle emissions and secondary aerosols formed from the gases emitted by the project to reduce visual ranges in Class I areas.

Twenty-four hour average "extinction coefficients" were used as a measure of regional haze impacts, and increased extinction results in a reduced visual range. A five percent change in extinction is generally used to indicate a "just perceptible" change to a landscape (Pitchford and Malm 1994). Extinction coefficients were calculated from the CALPUFF output files using the post-processing program CALPOST. Extinction coefficients were calculated for PM10 concentrations, sulfate concentrations, nitrate concentrations, and relative humidity.

Background data representative of extinction coefficients in the Class I areas were used for comparison with contributions expected from the proposed facility. Seasonal background extinction coefficients for Class I areas and the Mt. Baker Wilderness Area are shown in Table 3.1-18, and are based on monitoring data from the North Cascades National Park. These numbers reflect existing conditions.

Table 3.1-18: Seasonal Extinction Coefficients for Class I Areas in Northern Washington

Extinction (Mm^{-1})	Seasonal Non-Hygroscopic and Hygroscopic Extinction Based on North Cascades National Park			
	Autumn	Spring	Summer	Winter
b_{dry}	15.36	15.30	18.85	14.02
b_{SN}	1.44	1.65	2.72	1.03

Note: b_{dry} includes Rayleigh scattering of 10 Mm^{-1}.

North Cascades National Park data provided by NPS in March 1999. Background coefficients for the other areas are assumed to be equivalent to the North Cascades National Park per 1999 data from USFS.

The CALPUFF modeling system was used to calculate 24-hour average extinction coefficients for each day of the year. In addition, the operating scenarios involving gas-fired turbines and supplemental duct burners for all four seasons were evaluated. CALPUFF was also used to evaluate potential oil-fired emissions during the winter months.

Modeling results indicated that for all seasons, the highest extinction coefficients were relatively close to the S2GF site in the Lower Fraser Valley and south of Sumas towards Bellingham. The highest maximum extinction coefficients occur during periods of gas shortages when oil firing would occur. The facility would contribute less to regional haze under more normal operating conditions.

Table 3.1-19 shows the maximum project-related predicted 24-hour aerosol concentrations and extinction coefficients by Class I area and season. Aerosol concentrations and extinction coefficients are much lower in the Class I areas than in lower elevations because transport to the Class I areas usually occurs under meteorological conditions that do not favor aerosol formation. With the exception of the Glacier Peak Wilderness area, the highest potential aerosol concentrations and extinction coefficients are all expected when the proposed facility is oil-fired.

Table 3.1-19: Maximum Species Concentrations by Season

Class I Area	Maximum 24-hour Predictions from S2GF Sources			
	NO3 ($\mu g/m^3$)	SO4 ($\mu g/m^3$)	PM10 ($\mu g/m^3$)	Extinction Coefficient (1/Mega-m)
Spring (a)				
Olympic National Park	0.0095	0.0007	0.0390	0.469
Alpine Lakes Wilderness	0.0041	0.0004	0.0139	0.356
Glacier Peak Wilderness	0.0048	0.0005	0.0232	0.252
North Cascades Nat. Park	0.0126	0.0011	0.0493	0.755
Pasayten Wilderness	0.0054	0.0004	0.0220	0.367
Max Class I Areas	0.0126	0.0011	0.0493	0.755
Mt. Baker Wilderness (b)	0.0189	0.0019	0.0924	1.406
Summer (a)				
Olympic National Park	0.0012	0.0001	0.0070	0.077
Alpine Lakes Wilderness	0.0024	0.0003	0.0112	0.124
Glacier Peak Wilderness	0.0033	0.0005	0.0187	0.165
North Cascades Nat. Park	0.0069	0.0014	0.0591	0.723
Pasayten Wilderness	0.0028	0.0004	0.0187	0.219
Max Class I Areas	0.0069	0.0014	0.0591	0.723
Mt. Baker Wilderness (b)	0.0129	0.0018	0.0831	1.032
Fall (a)				
Olympic National Park	0.0004	0.0004	0.0161	0.225
Alpine Lakes Wilderness	0.0003	0.0003	0.0133	0.217
Glacier Peak Wilderness	0.0004	0.0004	0.0219	0.236
North Cascades Nat. Park	0.0004	0.0004	0.0213	0.364
Pasayten Wilderness	0.0002	0.0002	0.0129	0.160
Max Class I Areas	0.0004	0.0004	0.0219	0.364
Mt. Baker Wilderness (b)	0.0009	0.0009	0.0650	0.938
Winter (a)				
Olympic National Park	0.0070	0.0005	0.0203	0.481
Alpine Lakes Wilderness	0.0030	0.0002	0.0065	0.124
Glacier Peak Wilderness	0.0009	0.0001	0.0032	0.050
North Cascades Nat. Park	0.0027	0.0004	0.0282	0.263
Pasayten Wilderness	0.0020	0.0003	0.0241	0.232

Class I Area	Maximum 24-hour Predictions from S2GF Sources			
	NO3 ($\mu g/m^3$)	SO4 ($\mu g/m^3$)	PM10 ($\mu g/m^3$)	Extinction Coefficient (1/Mega-m)
Max Class I Areas	0.0070	0.0005	0.0282	0.481
Mt. Baker Wilderness (b)	0.0058	0.0004	0.0340	0.288
Winter Oil-fired (c)				
Olympic National Park	0.0187	0.0229	0.0565	2.346
Alpine Lakes Wilderness	0.0100	0.0096	0.0175	0.591
Glacier Peak Wilderness	0.0025	0.0030	0.0073	0.186
North Cascades Nat. Park	0.0072	0.0283	0.0963	1.315
Pasayten Wilderness	0.0061	0.0187	0.0629	1.050
Max Class I Areas	0.0187	0.0283	0.0963	2.346
Mt. Baker Wilderness (b)	0.0143	0.0359	0.1231	1.279
Maximum All Cases				
Olympic National Park	0.0187	0.0229	0.0565	2.346
Alpine Lakes Wilderness	0.0100	0.0096	0.0175	0.591
Glacier Peak Wilderness	0.0048	0.0030	0.0232	0.252
North Cascades Nat. Park	0.0126	0.0283	0.0963	1.315
Pasayten Wilderness	0.0061	0.0187	0.0629	1.050
Max Class I Areas	0.0187	0.0283	0.0963	2.346
Mt. Baker Wilderness (b)	0.0189	0.0359	0.1231	1.406

(a) Simulations based on gas-fired turbines under base load with supplemental firing with duct burners.

(b) Mt. Baker Wilderness is not a Class I area. Predictions provided for information purposes only.

(c) Simulations based on oil-fired turbines under base load.

Under normal operating conditions, the highest extinction coefficients are expected during the spring for the other Class I areas except for Olympic National Park, which is more heavily influenced during the winter.

Table 3.1-20 shows the maximum predicted change in 24-hour extinction coefficients for each Class I area and season. Under normal operating conditions, estimated extinction coefficients are less than the five percent criterion suggested by the Department of Ecology and described earlier in this section.

Using the five percent criterion described earlier in this section, changes to visual conditions in the Class I areas would not be perceptible when the S2GF turbines are gas-fired. However, the modeling indicates that oil-fired emissions, when combined with unfavorable meteorological conditions, may result in perceptible regional haze in Olympic National Park and the North Cascades National Park (i.e., may exceed the five percent criterion). Under the modeling scenarios used in this analysis, these meteorological conditions occurred for four days of the 15 total days expected from December through February when the turbines could be fired by oil during a gas shortage.

Table 3.1-20: Maximum Change in Extinction Coefficient

Class I Area	Maximum Predicted Change 24-hour Extinction Coefficient (%)				
	Spring (a)	Summer (a)	Fall (a)	Winter (a)	Winter Oil-Fired
Olympic National Park	2.01	0.25	0.95	1.97	9.58
Alpine Lakes Wilderness	0.91	0.39	0.77	0.61	2.89
Glacier Peak Wilderness	1.22	0.75	1.23	0.21	0.85
North Cascades National Park	2.54	1.49	1.44	1.31	7.50
Pasayten Wilderness	1.40	0.66	0.68	1.15	4.47
Max Class I Areas	2.54	1.49	1.44	1.97	9.58
Mt. Baker Wilderness (b)	4.04	2.79	3.71	1.61	7.16

(a) Simulations based on gas-fired turbines under base load with supplemental firing with duct burners.

(b) Mt. Baker Wilderness is not a Class I area. Predictions provided for information purposes only.

Odors

Maintenance of the S2GF may include some activities that generate odors. If oil-based paints are applied to structures or equipment at the site, paint odors may be perceptible nearby. Portions of the site will be paved with asphalt, and asphalt fumes during repaving may be perceptible for a short period of time during the paving operations. These impacts are expected to be slight and of short duration.

Operation of the facility would not generate odors that are perceptible offsite. The threshold of perceptibility for ammonia is approximately 0.5 ppm, or about 350 $\mu g/m^3$ (National Academy of Sciences 1979). If SCR is selected as BACT for NOx, approximately 32 pounds of ammonia would “slip” through the NOx control equipment and be emitted from each HRSG. Based on the dispersion modeling results (see Table 3.1-13), this maximum emission rate would result in a ground-level hourly average concentration of approximately 6 $\mu g/m^3$ when both turbines are operating at base load with duct firing. As a result, ammonia odors attributable to the S2GF would not be perceptible offsite.

Cooling Tower Plumes

Cooling tower cells would produce water vapor clouds that vary in size depending on local meteorology and facility operational factors. A detailed analysis of the cooling tower plumes was conducted to evaluate four potential issues: (1) the presence of visual plumes from the towers, (2) the occurrence of fogging and/or icing involving the ground contact of visible plumes, (3) shadowing effects, and (4) the impact of droplets of cooling water, called drift.

A computer program designed by the Argonne National Laboratories for the Electric Power Research Institute was used to evaluate cooling tower plumes. Information entered into the model included design information on the cooling tower system and local meteorological data. The model was applied to simulate plumes from the proposed cooling tower using the five-year meteorological data set from Abbotsford Airport and preliminary tower design characteristics.

The major conclusions of the cooling tower assessment were:

- Visible plumes would usually be of short duration and would not obscure visual resources in the area. Except for an area within 100 meters of the cooling tower, plume shadows would occur fewer than 120 hours per year.
- Due to the moist climate of the region, long condensed plumes may occasionally occur during periods of elevated relative humidity. Such condensed plumes would typically occur at night or during conditions of poor or obscured visibility. During periods of good visibility, condensed plumes would be less than 50 meters in length on average. The probability of a condensed plume longer than one kilometer is approximately one percent during such conditions.
- Plume induced ground-level fog would be very infrequent, occurring for less than one hour per year.
- Icing was not predicted for any hour during the five-year simulation.
- Drift impacts would also be low and confined to the immediate project area. Drift deposition would primarily be limited to an area within 100 meters of the cooling tower and would not be greater than 1.5 kilograms per kilometer per month beyond this distance. The majority of the drift would be comprised of water soluble salts that would be carried away by rainfall. No buildup of drift is expected.

Greenhouse Gases

A general consensus exists within much of the scientific community that "greenhouse gases" are concentrating in the atmosphere and that elevated concentrations of these gases will result in global warming, potentially affecting the earth's climate. There is less agreement as to when these effects might become significant, how rapidly they may occur, how intense they might be, or what the long-term social, cultural, political, and economic effects may be.

The principal greenhouse gases are carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), tropospheric ozone (O_3), and chlorofluorocarbons (CFCs). The "greenhouse effect" refers to the "trapping" of solar radiation, a consequence of the fact that these gases impede the re-radiation of solar energy from the earth's surface more efficiently than they impede incoming solar radiation. Since these gases are distributed throughout the atmosphere, the net result is similar to that of a global greenhouse.

The various greenhouse gases contribute to global warming to different degrees. The relative contribution of CO_2 to global warming is estimated to be roughly equal to that of all other greenhouse gases combined. There is consensus that CO_2 released by fossil fuel combustion is the largest single source contributing to global warming, accounting for up to one-half of the total.

According to Westinghouse's *Expected 501F Combustion Turbine Performance* specification (Siemens Westinghouse 1999), each of the two turbines firing gas at base load with duct firing, or firing oil at base load, would emit approximately 140 tons of CO_2 per hour. If both turbines were to fire oil for 15 days and fire gas with duct firing for the remaining 350 days, the facility would emit approximately 2.4 million tons of CO_2 annually.

Given a decision to burn fossil fuels, CO_2 and CH_4 emissions can be minimized by maximizing the efficiency of the combustion process so less fuel is consumed per unit of electrical energy produced. To the extent a natural-gas fired plant such as the S2GF is an alternative to generation fired by other fossil fuels (e.g., coal), it would help to relatively reduce greenhouse gases.

The selection of combustion turbine combined cycle generating units represents the most efficient technology of all power systems and, with efficient operation, is the highest and best practical control for greenhouse gas emissions from electric power generation. Natural gas contains less carbon than any other fossil fuel and natural gas-fired plants burn cleaner and are more efficient than oil or coal.

No regulatory requirement for greenhouse gas mitigation has yet been promulgated by the State of Washington, the federal government, or at the international level. However, Oregon has adopted a greenhouse gas policy pertaining to combustion turbine-based electrical generating facilities. In response to a request from EFSEC, the applicant has reviewed and given strong consideration to the Oregon policies. Although British Columbia has not adopted a formal greenhouse gas policy, the applicant has also consulted with knowledgeable Canadian agency staff and reviewed greenhouse gas proposals recently prepared by Canadian industries.

The applicant has prepared a Greenhouse Gas Offset Strategic Plan (Dames & Moore 2000) for carbon management and mitigation that addresses greenhouse gas emissions from the proposed facility and techniques for CO_2 mitigation. The applicant proposes to offset as much carbon as possible through the voluntary investment of $100,000 per year in greenhouse gas research, offsets, or management projects for ten years. Rather than paying a single up-front charge, the applicant proposes to carry carbon offset as an operating expense, investing $100,000 at the end of each of the first ten years of the facility's operation.

Offsite Facilities

There would be no air quality impacts anticipated with the operation of a natural gas pipeline, water or wastewater lines, or electric transmission lines.

3.1.5 Environmental Impacts of No Action

Under the No Action Alternative, air pollutants would not be emitted from the project site. It is likely, however, that the demand for electrical power would be met by a similar facility at another Northwest site, and would emit similar pollutants.

3.1.6 Mitigation Measures

3.1.6.1 Construction

Dust from access roads and other fugitive dust sources will be controlled by applying gravel or paving the access roads, and by watering the roads as necessary.

3.1.6.2 Operation

No mitigation measures are proposed beyond those design elements intended to reduce air quality impacts (Chapter 2).

3.1.7 Cumulative Impacts

Emissions from the proposed facility were added to "existing" pollutant concentrations to estimate cumulative impacts. Cumulative emissions of criteria pollutants are below ambient standards.

3.1.8 Significant Unavoidable Adverse Impacts

Although the proposed project would result in an increase in air emissions, no significant adverse air quality impacts would occur.